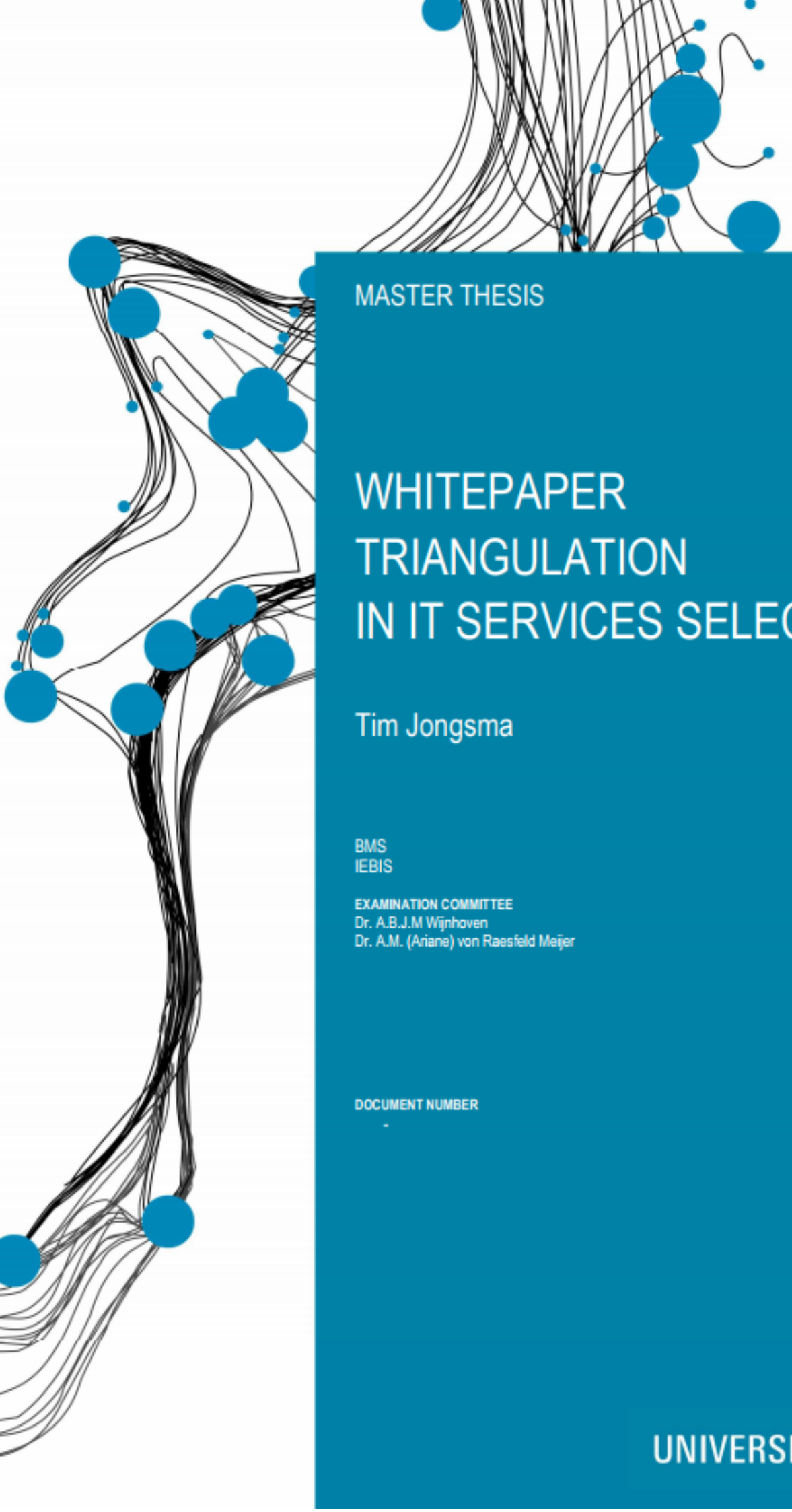

MASTER THESIS

WHITEPAPER TRIANGULATION IN IT SERVICES SELECTION

Tim Jongsma

BMS
IEBIS

EXAMINATION COMMITTEE
Dr. A.B.J.M Wijnhoven
Dr. A.M. (Ariane) von Raesfeld Meijer

DOCUMENT NUMBER
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UNIVERSITY OF TWENTE.

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ABSTRACT

According to case studies online documents are considered to be the main source of information during the selection process for IT outsourcing. Research has shown consequently that readers often lack the skills to efficiently and correctly asses the credibility of online documents. This paper proposes a whitepaper triangulation tool based on inquiring systems to aid managers in determining the credibility of whitepapers and thereby expediting the professional service firm selection process. Existing literature and case studies are used in order to define requirements, design and validate a whitepaper triangulator.

Keywords: Credibility, Internet information, Inquiring systems, IT outsourcing, PSF selection, Triangulation, Whitepapers

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1 INTRODUCTION

Research has shown consequently that readers often lack the skills to efficiently and correctly asses the credibility of online documents (Metzger & Flanagin, 2013). Back in the days when most documents were distributed on paper credibility, could be provided by third parties such as publishers. However, since web 1.0 everyone can be an author. Recent media attention has uncovered that this open character of internet information also leads to a lower level of credibility, a phenomenon which has been confirmed by academic research (Metzger, 2007).

Companies often outsource business processes which are not part of their core business to external professional service firms. Experience with outsourcing are not always positive. For example the majority of United State industries (70%) appears to have had negative experiences with outsourcing (Liou & Chuang, 2010). The most common cause of these negative experiences appears to be a lack of comprehensive evaluations during the selection of professional service firms. Information seeking is one of the stages of the Professional service firms (PSF) selection process (Makkonen, Olkkonen, & Halinen, 2012). A lack of skills to efficiently and correctly asses the credibility of online documents might therefore negatively impact the PSF selection process.

PSF's promote their capabilities online through corporate websites. They might also describe their solutions in whitepapers in order to convince possible clients of their capabilities. In contrast to academic papers whitepapers are not thoroughly peer-reviewed before publication and therefore have no third-party credibility. This makes it difficult and time consuming to value the credibility of whitepapers and filter out biased information.

Metzger (2007) describes the need for techniques to critically evaluate online information as most people are unprepared to assess the credibility of online documents. Therefore, this paper proposes a whitepaper triangulation tool based on the use of an internet triangulator as described by Wijnhoven & Brinkhuis (2015).This tool could aid managers in the process of searching and evaluating whitepapers.

The goal of this research is to design, build and evaluate an internet triangulation tool in order to aid the evaluation of whitepapers during the PSF selection process.
In order to design and test such a tool two questions will be answered.

1. What are the requirements for a PSF whitepaper triangulation tool?
2. Does internet triangulation of white papers aid the selection of professional service firms?

This research will focus on the selection of PSF's active in the IT sector. These PSF generally deliver IT products or services to a broad market as most companies use IT services these days. IT services are considered to be credence goods, due to their technical complexity and specialised knowledge (Howden & Pressey, 2008). The

information asymmetry this causes might enlarge the impact of the lack of adequate document information skills.

This paper will now proceed as follows. First the kernel theory concerning PSF outsourcing, PSF selection, whitepapers and information triangulation will be discussed. Second, the design methodology and methods of validation will be described. The next chapter incorporates the kernel theory into the meta-requirements for the different artefacts. These meta-requirements are the basis for the design as discussed in chapter five. Chapter six contains the results of the validation of the proposed whitepaper triangulator. Finally, we discuss the findings from this research and implications on future work.

2 KERNEL THEORY

A structured literature search was performed via SCOPUS. Queries for both questions were created (see table 1).

Query	Documents
TITLE-ABS-KEY (("professional service"* OR consultan*) AND (criteria OR purchasing OR decision OR choice)) AND (LIMIT-TO (SUBJAREA,"BUSI "))	25
TITLE-ABS-KEY (whitepaper* AND triangulation)	0
TITLE-ABS-KEY (internet AND information AND triangulation) AND (LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2014))	34

TABLE 1 QUERIES USED FOR STRUCTURED LITERATURE SEARCH

As no papers could be found about triangulation of whitepapers. The literature review was focussed on the more general domain of internet information triangulation as the techniques used in internet information triangulation are expected to be applicable on whitepaper triangulation.

The documents found were further filtered by reading the abstracts and selecting only those papers deemed usable to answer the questions. Apart from the articles gathered through Scopus also relevant articles referenced in these articles are used in order to obtain more elaborate information.

2.1 Professional service outsourcing

Companies choose to outsource non-core business processes to external suppliers (Gadrey & Gallouj, 1998). Liou & Chuang (2010) define outsourcing as devising a contract with an external organisation to take primary responsibility of providing business processes. The idea behind outsourcing is that products or services can be supplied more efficiently and better by an outside provider. Therefore, outsourcing non-core activities can strengthen companies strategic focus and free capabilities to increase cost-efficiency and leverage economics of scale (Hallikas, Immonen, Pynnönen, & Mikkonen, 2014). The organisations to outsource these processes to are called professional service firms (PSF).

For example, financial accounting might be outsourced to an external supplier in order to save overhead costs. Another example could be the outsourcing of the development of a new IT tool because the internal knowledge base is insufficient to develop the tool in house. Von Nordenflycht (2010), states that professional service firms are examples of extreme knowledge intensity. Through this knowledge they are increasingly more relevant to non-PSF's. He describes three characteristics that distinct PSF's from other firms:

1.Knowledge intensity is described as the most distinctive characteristics of PSF's. As their services depend on a substantial amount of complex knowledge, which is mostly embodied in individuals and not in equipment.
2.Low capital intensity implies that PSF's do not rely on expensive equipment, inventories or facilities. Instead these firms rely on employee skills.
3.Regulated professional workforce indicates that the workforce of these companies is based on professions. Professions exist of three key features. First of all, there should be a considerable knowledge base. Secondly, this knowledge base should be exposed to regulations and control (Von Nordenflycht, 2010). This could result in a knowledge monopoly owned by the profession or regulated by states. Lastly, professions should feature an ideology referring to ethical codes and social norms regarding professional behaviour.
4.IT intensity in addition to these three characteristics, we propose a fourth which defines whether the PSF makes extensive use of modern information technologies in providing their professional service. This characteristic differs from knowledge intensity as the intensive use of IT requires specific knowledge but also investments in specialist equipment and infrastructure.
5.IT capital intensity also an addition to the original three characteristics, indicates whether or not a PSF has heavily invested in IT resources in order to supply services. For example while software developers and cloud providers are both IT intensive, cloud providers will also need to invest in servers and network infrastructure.

The presence or absence of these characteristics results in five different types of PSF's.

Characteristics → PSF Type ↓	*Knowledge intensity*	*Low capital intensity*	IT intensity	Regulated workforce	IT capital Intensity
Classic PSF's	X	X		X	
Professional campuses	X			X	
NEO PSF's	X	X			
Technology Developers	X		X		
IT Service providers	X		X		X

TABLE 2 FIVE TYPES OF PSF'S.

Classic PSF's incorporate; knowledge intensity, low capital intensity and a regulated workforce. Examples are Law and Accounting service providers. Professional campuses possess the knowledge intensity and professional workforce characteristics but lack the low capital intensity. Hospitals are great examples with their expensive facilities and equipment. Neo-PSF's differ from Classic PSF's in their weakly professionalized workforce the knowledge used in these companies might be extensive but is not regulated as is the case in classic PSF's. Consultancy and advertising firms could be categorized as Neo-PSF's. Technology Developers, such as R&D labs, are knowledge intensive but do not show the characteristics of low capital intensity and professional workforce.

In addition to the four types of PSF's as mentioned by Von Nordenflycht (2010) we propose a fifth. IT Service providers (Wijnhoven, 2011) are knowledge intensive but also IT capital intensive because of the necessary infrastructure. These companies do not focus on delivering new technologies but on delivering IT services (Lacity, Khan, & Willcocks, 2009). As this different business focus also provides different risks and challenges such as contracts we argue that the addition of a fifth category is justified.

Outsourcing of non-core business processes to PSF's can be done in two ways (Gadrey & Gallouj, 1998):

1. **Substitution outsourcing:** Outsourcing non-core business processes to an external supplier in order to save overhead costs.
2. **Complementary outsourcing:** Outsourcing business processes as well as keeping them inhouse combining internal and external knowledge and skills.

The decision to outsource certain processes might influence the capabilities of a firm in the future as knowledge is transferred to the PSF (Tiwana, 2013). This is part of a process of knowledge integration which could take place when certain processes are outsourced. During this process the service buyer and supplier invest in knowledge in the domain of the other party. This provides better integration of the processes (Tiwana, 2013).

Outsourcing can also be categorized based on the relation between the company buying the service and the supplier. First there is the perspective of interaction, in some cases the supplier works together with the company to create a solution, called sparring. In other cases, the PSF just delivers a service with minimal interaction with the buying company, called jobbing. Another perspective is that of the degree of implementation which defines whether the solution is also implemented by the supplier. Combined these two perspectives lead to four different types of outsourcing relations (Gadrey & Gallouj, 1998).

Degree of implementation / Mode of interaction	Outsourcing without implementation	Outsourcing with implementation
JOBBING	1) Analysts and architects	2) Project engineers
SPARRING	3) Co-Pilots	4) "Doctors in management"

TABLE 3 PSF PRODUCTION/DELIVERY, BASED ON GRADEY & GALLOUJ (1998)

Professional services can be identified as credence goods (Howden & Pressey, 2008). This is especially the case when considering professional IT services. The technical complexity and specialised knowledge of these services leads to information asymmetry between the buyer and supplier. This makes it difficult for the buyer to asses the value of the professional service before and after consumption. Therefore, the buyer will need to trust the supplier that the proposed solution is in their business best interest. Because of this professional services are perceived as high risk purchases (Howden & Pressey, 2008).

2.2 Professional service firm selection

Independent of which method of outsourcing is chosen companies will have to decide on a supplier for professional services. Liou & Chuang (2010) state that this in often unsuccessful due to the lack of an comprehensive evaluation. Yang, Kim, Nam, & Min (2007) add to this that selecting a PSF is a time-consuming process and that it will normally cost a CIO 80% of his or her time during three to six months.

The process to evaluate and select a PSF consists of seven steps according to Monczka, Handfield, Giunipero, Patterson, & Waters (2016).

1. Recognize the need for supplier selection
2. Identify key sourcing requirements
3. Determine sourcing strategy
4. Identify potential supply sources
5. Limit suppliers in selection pool
6. Determine method of supplier evaluation and selection
7. Select supplier and reach agreement

However Makkonen, Olkkonen, & Halinen (2012) state that the buying process is mostly considered a linear progression based on bounded rationality existing of; identifying needs, information gathering and processing and an objective evaluation. They add to this that this process can be better described as muddling through as different actor context and conflicting politics are not in line with a linear process. We argue that independent of the linear or muddling through structure of this process the information seeking and processing step will always be present. And therefore, we expect that tools for adequate assessment of this information are of added value.

When gathering information, for example about potential suppliers, a consideration needs to be made about the amount of resources invested into the search. A limited

search might cause potential suppliers to be left out or poorly evaluated, but an over extensive search becomes too expensive (Monczka et al., 2016). Information can be gathered from numerous sources these are but not limited to: current suppliers, sales representatives, internet searches, internal sources, internet searches and industry journals.

As in general product development speeds increase, the PSF selection process speed will need also need to increase. At the same time the amount of information available through online sources grows. This poses a challenge to managers who need to gather and select information and shows the need for tools to aid in this process. De Boer, Labro, & Morlacchi (2001) show a number of methods which can be used during the identification and selection of supplier stages. However, these methods are focussed on the selection of industrial products. Due to the credence characteristics of professional services it is difficult to asses the utility of the product before use. Therefore, these methods are not usable.

The criteria used to select a PSF differ between organisations as the context of the outsourcing problem influences which criteria are used and how they are weighted. In general selection criteria can be divided in eleven categories (Monczka et al., 2016).

Selection criteria categories
Management capability
Employee capabilities
Financial stability
Costs
Quality management
Process design and technology
Production scheduling and control systems
Environmental regulation compliance
E-commerce capability
Supplier's sourcing policies
Potential for longer term relationship

TABLE 4 SELECTION CRITERIA CATEGORIES (MONCZKA ET AL., 2016)

Liou & Chuang (2010) agree and stress that selection criteria are dependent on the context of the specific case but describe four selection categories which should be used when selecting a PSF: compatibility, risk, quality and cost. Yang et al. (2007) agree with this and state that environment should be one of the selection categories.

Rosenbaum, Massiah, & Jackson Jr (2006) state based on marketing theory that trust is integral to success. They reason that satisfaction of customers leads to trust which results in commitment. This is especially true for existing relationships where satisfaction could increase trust and thereby commitment through this mechanism.

When looking at customers of PSF's, Rosenbaum et al. (2006) state that it is difficult for the customer to assess the trustworthiness of a PSF before engaging in an actual relationship as professional services are credence goods. Therefore, there is a risk of

disappointment in the end. To avoid disappointment, buyers need information about reputation and quality of the supplier in order to reduce the information asymmetry.

With the advances in information technology it could be that criteria to select PSF's have changed. Especially the methods for retrieving information about possible candidates has probably changed with the major advances in information technology. A survey conducted in 2005 by McCole & Ramsey (2005) showed that 96.2% of the participated PSF's used Web-based communication and 61.4% had a corporate web site.

PSF selection is a complex decision process, multiple dimensions need to be evaluated and integrated in the decision. Consequently, PSF's need to deliver high quality information through their corporate websites to be evaluated before they can be asked to further present their solutions.

2.3 Whitepapers

Grey literature and in particular white papers, pose a new method of finding information about possible candidates. White papers are used by suppliers of professional services to outline their techniques and solutions to business problems and can be categorised as grey literature. Grey literature differs from academic literature in the fact that it is not peer reviewed and often less structured. Because of this it is difficult to determine the quality of the information (Adams, Smart, & Huff, 2016).

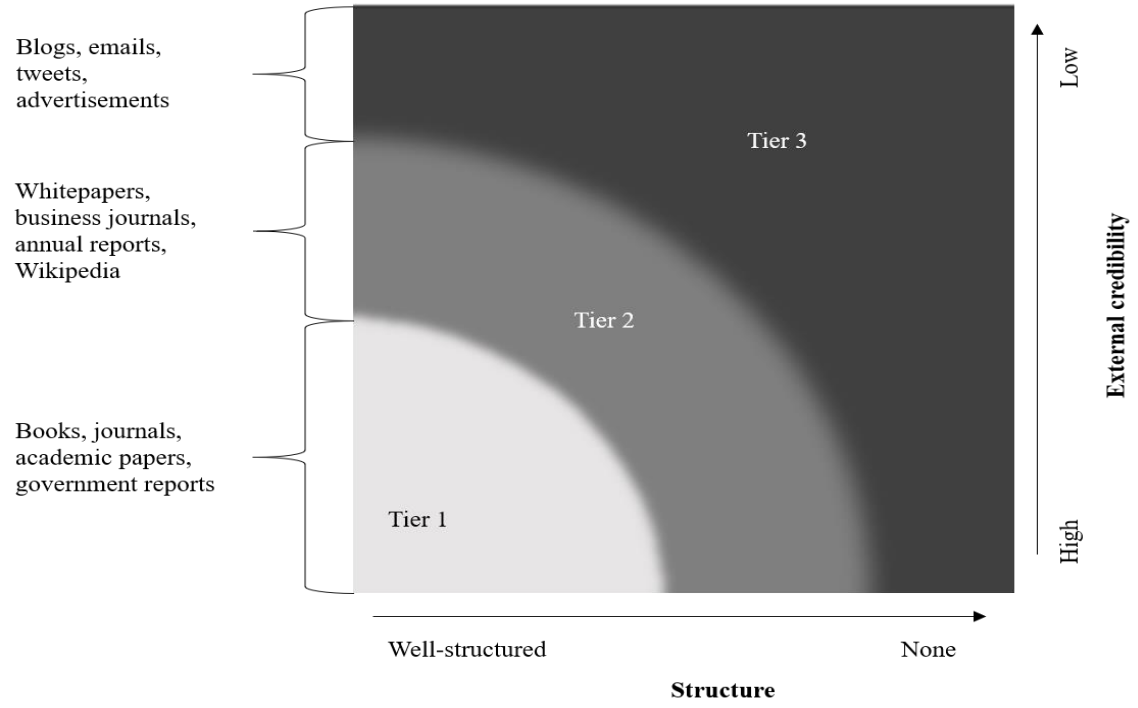

FIGURE 1 GREY LITERATURE CLASSIFICATION

Whitepapers bring a voice of experience and might help in bridging the gap between knowledge and practice (Adams et al., 2016). Thereby making them useful sources of

information for managers who need to decide on the choice of a professional service supplier.

Grey literature can be divided in a number of tiers (Figure 1). These tiers depend on the expertise of the source of the literature and the extent to which the publishing media confirms with explicit and transparent knowledge creation criteria (Adams et al., 2016). White papers can be categorized in any of these tiers, depending on the author and outlet control, but are mostly categorized as tier 2 grey literature as credibility due to external creditors such as publishers is absent. This lack of external credibility poses a problem for information consumers like PSF customers.

While the information set out in these documents can be of added value in their search for a PSF readers often lack the skills to assess the credibility of these documents without proper tooling (Metzger, 2007).

2.4 Information triangulation

The internet has enabled everyone to become an author, while this allows information to spread easily it also poses a threat of misinformation and forces information consumers to critically evaluate data (Metzger, 2007). A checklist approach consisting of five criteria: accuracy, authority, objectivity, currency and coverage can be used as a tool to assess document credibility. However Metzger (2007) shows that this approach is time consuming and that people tend to assess information more accurate if it is easier. Therefore, she suggests the creation of tools to aid in internet document evaluation.

Based on the inquiring systems as described by (Churchman, 1985), (Wijnhoven & Brinkhuis, 2014) propose an internet information triangulator. The four main inquiring systems and the pragmatic inquiring system are used as kernel theories for the different triangulators that together form the proposed prototype. These triangulators are:

1. Data triangulator
2. Theory triangulator
3. Investigator triangulator
4. Methodology triangulator

Using multiple triangulators enables us to look at information from multiple perspectives and enabling the detection of information biases.

As PSF selection is a complex process were information asymmetry exists it is important that firms are provided with high quality information. This information is available in whitepapers, however the quality of these whitepapers is difficult to assess due to their uncontrolled nature. A triangulator enables customers of PSF's to assess the documents which contain the information necessary to make the right purchasing decision.

Therefore, a whitepaper triangulator should be able to provide insight in the quality of this information by unravelling possible biases created by the author. Furthermore, as selection criteria are context dependant a whitepaper triangulator should determine the match between the document and the customer context.

3 METHODOLOGY

3.1 Design science

To answer the second question, does internet triangulation on white papers influence the selection of professional service suppliers? We design and build a tool using the design science paradigm. This tool enables users to triangulate white papers and enables us to find how such a tool could aid companies in selecting PSF's. Results from this analysis could then be used to determine future research.

To design this tool we follow the principles of a design study as described by Hevner, March, Park, & Ram (2004). They describe design science as a science based on problem solving with its roots in engineering, as opposed to empirical and behavioural science which main goal is to define and proof theories and hypothesis. This approach is used as the goal of this research is to provide a tool to aid managers in the selection of professional service firms. This provides a tangible problem to be solved in line with the characteristics of a design study (Walls, Widmeyer, & El Sawy, 1992).

(Walls et al., 1992) introduce the concepts of a product and a process-oriented approach. The process-oriented theories which explain how complex outcomes evolve or develop over time. This approach is often used for the design of systems which analyse complex event driven data (Adomavicius, Bockstedt, Gupta, & Kauffman, 2008). In this research we adopt a product oriented approach which is aimed at the development of new artefacts (Adomavicius et al., 2008).

Walls et al. (1992) describe product-oriented approach theories as consisting of four elements:

1. Kernel theory
2. Meta-requirements
3. Meta-design
4. Tests

Hevner (2007) argues that this approach exists of three cycles which align with these elements. The relevance cycle defines the goal of the research and the problem to be solved. It also provides a context for the research as well as acceptance criteria in order to evaluate the research. The rigor cycle incorporates existing knowledge into the research. This knowledge is identified by (Walls et al., 1992) as the Kernel theory and grounds the research. Furthermore, it also includes additions to the knowledge base through new meta-artefacts and theories thereby justifying the research. The design cycle consists of the actual core of the research. Using the requirements defined in the relevance cycle the additions to existing knowledge in the rigor cycle are created.

Cleven, Gubler, & Hüner (2009) state that in order to determine the effectiveness of the artefacts evaluation is of major importance. This evaluation relates to the field testing within the relevance cycle as described by Hevner (2007). In order to evaluate the proposed triangulation tool we use the evaluation framework as described by Cleven et al. (2009).

The goal of this evaluation is to better understand the performance of the different artifacts for gaining new knowledge which would enable to further develop them in the future. With performance we mean the actual influence of the tool on the PSF selection process.

3.2 Case study

First, to validate the context of whitepaper triangulation within professional service firm selection, we investigate four cases of companies who recently outsourced IT services. By investigating the PSF selection process we gain more insight into this process, identify the use of internet information and establish the need for a whitepaper triangulator.

To collect the data needed to investigate these cases we use interviews. The use of semi-structured interviews with individuals involved in the selection process will allow us to find out more about companies' selection processes for PSF's. Including the reasoning behind these practices. Participants are selected based on their experience and leading role within the respected PSF selection processes (see Appendix B). A fully-structured interview technique would limit the possibilities to find the backgrounds behind these processes (Allan & Emma, n.d.). In order to execute these interviews an interview guide was created consisting of interview topics and questions (see Appendix A).

3.3 Think aloud

Second, we set up an experiment using the think aloud methodology. Using this methodology participants will be asked to voice the words of their minds (Charters, 2003) while using the triangulation tool. These participants will consist of professionals who have experience with PSF selection processes for outsourcing IT services (see Appendix B).

This will enable us to achieve an image of the performance of the tool within the actual context it was designed for. Charters (2003) states that thinking aloud should only be used for verbal tasks as verbal tasks lead to verbal instead of abstract thoughts. Verbal thoughts can be spoken aloud by a participant while an abstract thought has to be converted to a more simplified verbal thought by the participant first which makes them less accurate. As a triangulation tool is text based we consider this method applicable.

Furthermore, the activity the participants undertake while thinking aloud is of an intermediate verbal level. Simple tasks deliver a direct response where no verbal thoughts have taken place. This makes it difficult for the participant to speak his or her

thoughts aloud. When tasks become too complex they don't fit in the working memory of the participant anymore which makes the spoken thoughts inaccurate as verbal thoughts are only accurate if they appear rapidly after the thought process (Charters, 2003).

In order to validate the interpretation of the thoughts by the interviewer and to fill any possible gaps in the transcripts, a retrospective interview is held directly after the think aloud session. This is done directly after the session as answers will be most reliable without a time gap. Charters (2003) indicates that think aloud studies are often performed with small sample sizes providing examples of 6 and 9 participants due to the time expensive nature of this method. In a research with a similar subject as this research 15 participants were used in a think aloud study (Rieh, 2000). The document used for this procedure can be found at: https://www.sisense.com/whitepapers/5-signs-its-time-you-move-toward-a-business-intelligence-solution/.

3.4 Whitepaper triangulator influence

Third, we will ask participants to score whitepapers based on credibility indicators as determined by Appelman & Sundar (2016). Participants will rate the whitepapers using the prototype triangulation tool and by conventional reading. The differences between these scores will reflect the influence of the triangulation tool on perceived credibility. In order to negate the effect of order in this experiment a control group will only read or triangulate the whitepaper.

Participants in the survey consist of approximately 25 academic students with a background in business administration such that the context of the research field will not influence the results. In order to determine the influence of triangulation on the perceived credibility of a whitepaper the participants are divided in two groups which also form the control group for the order influence. The whitepapers are selected such that whitepaper A is expected to have a low perceived credibility and whitepaper B a high perceived credibility.

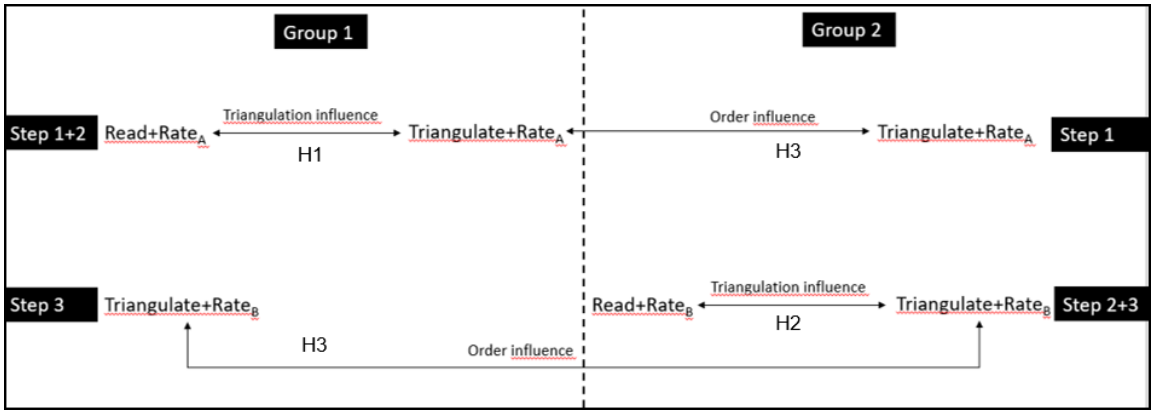

FIGURE 2 SURVEY SETUP

Group 1 is asked to first read and score whitepaper A and then triangulate and score the same whitepaper. Group 2 is asked to do the same for whitepaper B. Furthermore, the groups were asked to only triangulate the whitepaper of the other group in order to exclude the effect of reading the document before triangulation.

We expect the following effects to occur:

H1: Whitepaper-A$_{Credibility}$ will be lower after triangulation.
H2: Whitepaper-B$_{Credibility}$ will be higher after triangulation.
H3: Reading a whitepaper before triangulation will not influence the credibility after triangulation.

4 META-REQUIREMENTS

4.1 Data triangulator

The data triangulator is based on the Lockean inquiring system. Inspired by the thoughts of John Locke. Locke stated that all people are born without idea's and that knowledge is formed through observations of facts. This concept is also called empiricism and specifies that knowledge is a true representation of the world. This truth is achieved by a consensus. (Wijnhoven & Brinkhuis, 2014).

The data triangulator therefore focusses on the correctness of data and/or facts. In line with one of the five criteria as described by Metzger (2007): accuracy. Which entails that data found in online documents should be accurate in order to determine if the document is credible. Empirical research (based on the same concepts) provides us with two constructs in order to describe correctness. Reliability and validity, reliability corresponds to the consistency of a measurement. Validity tells us if a measurement is correct. (Allan & Emma, n.d.).

Popular examples of data triangulators are (online) fact checkers, such as politifact.com, which are widely used during political campaigns to check the factual validity of statements made by politicians. The implementation of a data triangulator should consist of the detection of facts and the determination if these facts are correct. This could be done by using information extraction tools to detect statements. These statements could then be checked for validity with a fact checker.

Data Triangulator Requirements
1. Able to detect factual statements
2. Able to check the correctness of facts extracted from the document.

Possible Tooling	
TextRazor (1)	API to extract entities and relations from text documents
IBM AlchemyLanguage (1)	API to extract entities and relations from text documents
NLTK (1)	Java library to extract Subject-Verb-Objects structures
CoreNLP (1)	Java library to extract Subject-Verb-Objects structures as well as other text features
Marseille (1)	Algorithm to detect facts in argument.
Fact checkers (2)	Fact checkers like the one created by the Washington post (poloitifact.com) indicate whether statements are true. These tools mostly focus on political statements.
Wolfram Alpha (2)	A source of factual information
Google knowledge graph (2)	A source of factual information

TABLE 5 DATA TRIANGULATOR REQUIREMENTS AND POSSIBLE TOOLING

4.2 Theory triangulator

The theory triangulator is based on the Leibnizian inquiring system and rationalism. Rationalism does not share the view that knowledge exists of facts instead it states that knowledge is created through reason. Therefore, knowledge can be created by individuals, and written down as formal systems. Correctness of these models depends on completeness and internal consistency (Mason & Mitroff, 1973).

To determine the completeness of a theory we could use argumentation theory as described by Toulmin (1958). This theory describes that a conclusion based on a claim could be reached through combining a proposition with a warrant and possible some form of backing and rebuttal. If at least the ground fact, warrant and claim are present the theory could be deemed complete.

The Kantian inquiring system adds that multiple ontologies could be used to describe one phenomena (Gregor, 2006). As the Kantian inquiring system argues that knowledge is created through the synthesis of multiple perspectives. Different cognitive styles people use might lead to these different perspectives and thereby to various views towards a problem (Franco & Meadows, 2007). Through identifying the different ontologies used in a document an indicator for the theoretical completeness of the document can be established.

The implementation of a theory triangulator as described by Wijnhoven & Brinkhuis (2014) should also entail the detection of causal relations and completeness of these relations. Girju & Moldovan (2002) describe two different techniques to detect these causal relations. The first is based on knowledge-based inferences. As these require large domain specific knowledge set this technique is less suitable to use in a generic tool therefore the second technique shows more potential. In this case the causal relations are detected using linguistic patterns. As this method does not require domain specific information it is better suited for the proposed tool.

Theory Triangulator Requirements
1. Able to detect ontologies
2. Able to detect causal relations
3. Able to visualize causal relations
4. Able to detect gaps in causal relations

Possible Tooling	
TextRazor (1, 2)	API to extract entities and relations from text documents
IBM AlchemyLanguage (1, 2)	API to extract entities and relations from text documents
NLTK (1, 2)	Java library to extract Subject-Verb-Objects structures
CoreNLP (1, 2)	Java library to extract Subject-Verb-Objects structures as well as other text features
Marseille (2)	Algorithm to extract argumentation
D3 (3)	Visualization library
Vis.js (3)	Visualization library
Sigma.js (3)	Visualization library

TABLE 6 THEORY TRIANGULATOR REQUIREMENTS AND POSSIBLE TOOLING

4.3 Investigator triangulator

The Hegelian system describes that knowledge is created through the synthesis of opposing views. The synthesis of different perspectives depends on their individual powers but might also be influenced by politics (Eisenhardt & Zbaracki, 1992). These politics are a result of the process where competing interests between the different perspectives clash. This indicates that there will always be a thesis and an anti-thesis. Therefore Wijnhoven & Brinkhuis (2015) indicate that it is important to find the views of the author of a document in order to determine its views and biases.

Lin, Spence, & Lachlan (2016) argue that one way through which credibility is achieved is through authority. This means that the credibility of a document is partially inherited from its author. When looking at whitepapers there might be two authorities as the author might be an individual but also an organisation. Metzger (2007) also describes authority as a criterion to establish the credibility of a document. In order for a document to be assessed as credible the reader should be convinced that the author is objective and that for example, no conflict of interest is in play. This is of special importance when considering that whitepapers are often written by paid employees for commercial gains.

Therefore, an investigator triangulator should find the author(s) of a document and their corresponding views and show these to the information consumer. This could be done by querying and summarizing other documents created by the author. The viewpoint of the author on the topic of the whitepaper could be analysed by performing a keyword sentiment analysis on documents created by the author (Medhat, Hassan, & Korashy, 2014).

Investigator Triangulator Requirements
1. Determine author of document/whitepaper
2. Determine author background in order to pinpoint possible biases
3. Determine author sentiment
4. Compare author's sentiment with global sentiment

Possible Tooling	
TextRazor (3)	API to extract entities and determine document sentiment
IBM AlchemyLanguage (1)	API to extract entities and determine document sentiment API to extract document author
Sentiment analysers (3,4)	Tools like Coosto, let us find global sentiment towards subjects in order to compare this to the authors sentiment.
Google knowledge graph (2)	Provides background info about authors
LinkedIn (2)	Provides background info about authors
Web search (2)	Provides background info about authors

TABLE 7 INVESTIGOTOR TRIANGULATOR REQUIREMENTS AND POSSIBLE TOOLING

4.4 Methodology triangulator

Method triangulation is based on the Kantian inquiring system. As mentioned earlier this inquiring system indicates that multiple perspectives could be used in order to explain a phenomenon or solve a problem. This is also applicable for different methods used in a document. As these methods have an influence on the reliability of the claims made in the document it is important to determine the different methods used in order to solve a problem or find a theory.

For example in the case of whitepapers it will be relevant to determine which of the different relationships between the customer and the PSF as described by Gadrey & Gallouj (1998) is used. More in general variables like sample size and diversity of research methods matter. Wijnhoven & Brinkhuis (2014) propose a keyword list in order to identify the different methods used in a document.

Campanelli & Parreiras (2015) show three different categorisations for research methodology's. First of all, they can be categorized based on the goal of the research. This goal could be to validate or evaluate something but also to provide an opinion or share an experience. The perspective of a validation research is rather different then a research with the goal to share an experience. Secondly Campanelli & Parreiras (2015) show a categorization based on five methodology types; Experiment, observational study, Experience report, case study and systematic review. The final categorization which is shown is based on the type of research question which is posed. Especially the second categorization based on the methodology type could be helpful to categorize triangulated documents once the used method has been found this could be used to search for parameters such as sample size which differ depending on the used methodology.

Methodology Triangulator Requirements
1. Determine methods used in document/whitepaper

TABLE 8 METHODOLOGY TRIANGULATOR REQUIREMENTS

4.5 Relevance triangulator

Wijnhoven & Brinkhuis (2014) argued that the Singerian inquiring system was represented in the effective use of the above-mentioned triangulation methods. However, we propose the addition of a fifth relevance triangulator.

The Singerian or pragmatic inquiring system proposes that the search for new solutions and theories is only meaningful when it reaches human progress (Churchman, 1985).

The pragmatic inquiring system does not care how these solutions or theories are created. But they should be relevant. Hjørland (2010) adds the factor of time to this concept indicating that even If a document might be considered irrelevant at this moment it might solve a future problem and thereby become relevant. He does however not mention that a document might also become obsolete when circumstances change. Metzger (2007) describes the criterium currency to establish document credibility, stating that when information gets out dated the credibility of a document should be questioned.

Arbesman (2012) does mention this decay of information over time. He reasons that facts have a half-time in parallel with for example nuclear material. The length of this half-time differs based on the type of knowledge. For example, stock prices have short half-times while theories created by the ancient Greeks have proven to be extensively relevant.

This process of obsolescence of knowledge as described by Arbesman (2012) is based on the theory that the truth of facts changes over time. During history the weight of the earth has changed multiple times. While at every moment in time the current weight of the earth was accepted as a fact newer research made this knowledge obsolete and replaced it with new facts.

The citation rate for academic articles is mentioned as a method to measure the half-time of knowledge (Arbesman, 2012). However while this method has been proven to work for academic knowledge (Matsubara, Sakurai, Prakash, Li, & Faloutsos, 2012) it is more difficult to implement for non-academic information sources because of the lack of a well-regulated reference policy.

Della et al. (2015) describe the obsolescence of knowledge as the decay of attention. Mentioning that attention for some subject fades over time. This definition of the obsolescence of knowledge is more generalisable and better suited for knowledge which is not subject to the rigor of academic policies. Furthermore, they show that attention is decaying more rapidly over time as new knowledge is becoming available at a faster rate.

A parallel is drawn to the fast diminishing attention for online material (Della et al., 2015). Matsubara et al. (2012) Show that online content shows various patterns of decay. In contrast to the decay of academic knowledge which is mostly exponential. Based on epidemiology they created a uniform model which is able to describe the decay of various kinds of knowledge.

Apart from time Hjørland (2010) lists over 80 factors found in literacy to be used when determining the relevancy of a document. He states that the number of factors is high as relevancy is influenced by context. For example, Dutch cultural influences on HRM practices in The Netherlands could be relevant for a company in The Netherlands but are less suitable for a corporation operating in Asia.

Metzger (2007) calls this the scope of a document. A different example of scope or context relevance is domain specific knowledge (Tiwana, 2013). This is knowledge or information which is relevant for example in a specific business domain. When looking at business practices, practices which are successful in one industry might be bound to that specific industry.

Davide, Noordegraaf, & Aroyo (2016) determined that document quality is established by readers through three constructs: accuracy, trustworthiness and precision. However like Hjørland (2010), Metzger (2007) and Tiwana (2013) they also state that the factors which create document quality through these constructs are context dependant. They add that also the reader of the document is part of this context and as this is the case readability is part of context relevance. A document which can be of great relevance for a PhD student writing a dissertation is of little relevance for a high school student and the other way around. The readability of a document could be determined using the Dale-Chall readability formula.

A relevance triangulator should check whether the knowledge in a document is still relevant and be able to determine whether the decay of this knowledge has already started if newer information is available (Hevner et al., 2004). Apart from that it should determine the context of the document containing localisation, business domain, target readers and more. This could be done by looking at the metadata of the document and searching for newer documents containing the same keywords and concepts.

Relevance Triangulator Requirements
1. Determine age of document
2. Determine context of document: geolocation, business sector etc.
3. Determine readability level of document
4. Find recent documents about the subject

Possible Tooling	
IBM AlchemyLanguage (1,2)	API to extract concepts of text which are not directly referenced freebase, dbpedia and yango
Internet search (4)	To find recent documents about a subject
Dale-Chall readability formula (3)	Provides readability score of a document

TABLE 9 RELEVANCE TRIANGULATOR REQUIREMENTS AND POSSIBLE TOOLING

5 META-DESIGN

Based on the requirements described above and summarized in Table 10 we propose a design for a whitepaper triangulation tool. This design consists of 7 modules as shown in Figure 4.

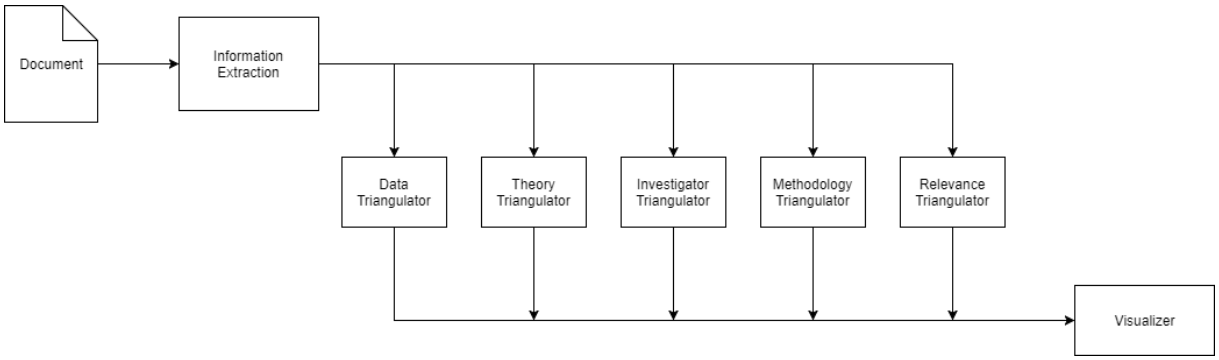

FIGURE 3 WHITEPAPER TRIANGULATOR ARCHITECTURE

The starting point of the triangulation tool will be the whitepaper document. This document serves as input for the first module. This first module, the Information extractor, extracts features like entities, key phrases, topics and authors from the document. These text features can be used by the separate triangulator modules. The output of these triangulator modules is then visualized by the last module in order to improve usability of the triangulator (Metzger, 2007)

The tool will be written using the programming language Python as the two extraction tools which are critical to this tool both provide interfaces in Python. The screenshots in this section show the results of the triangulation of the white paper titled: 5 sings it's time to move towards a business intelligence solution (https://www.sisense.com/whitepapers/5-signs-its-time-you-move-toward-a-business-intelligence-solution/).

5.1 Information extractor.

First, we extract metadata and the actual content from a document. Then we extract key features for the actual triangulation process from the text.

The actual extraction of these features is done using the API's from TextRazor("TextRazor," n.d.) and IBM Alchemy Language ("IBM AlchemyLanguage," n.d.). While both tools provide overlapping features, we use both as we have seen results in entity and relation extraction from TextRazor based on preliminary tests. While IBM Alchemy Language provides additional information like author, concept and sentiment extraction. This information will then be stored into a data model which can be used by the triangulator modules.

5.2 Data triangulator

In order to check the correctness of facts provided in the document we first need a method to detect these facts. While the data provided by the information extractor contains relations between entities. It is impossible to state based on these relations alone whether the author is stating a fact. Therefore, we will use the argument extraction, described as part of the theory triangulator, to detect factual statements. This argument extractor returns arguments with their corresponding classification. In order to detect facts, we look at arguments of the type fact.

FIGURE 4 SCREENSHOT DATA TRIANGULATOR

While numerous fact checkers exist, most consist of preselected statements in a limited context. For example, politics. As we are not able to determine the context of the detected facts we are not able to establish the correctness of these facts. However, if the document contains citing's underlying these facts this does increase credibility. Therefore, we search the document for citing's using standardized formats such as the American Psychological Association citing style. While we need to consider that some factual statements can be seen as common knowledge and therefor need no support from other sources, the ratio between facts and citing's can be seen as an indicator of the factual correctness of the document based on the data it holds.

5.3 Theory Triangulator

IBM Alchemy Language's concept extraction feature is used in order to determine the ontologies or concepts featured in the document.

Using the dependency graphs provided by the information extraction module using TextRazor in combination with the entity relations mentioned above we tried to create graphs containing causal relations existing within the document. However, due to the nature of text documents this results in a large number of partial graphs. Missing links could be seen as an indicator for causal relations which are incomplete but in many cases these links were missing due to the relation extraction process. Therefore, this could not be used a correct indicator.

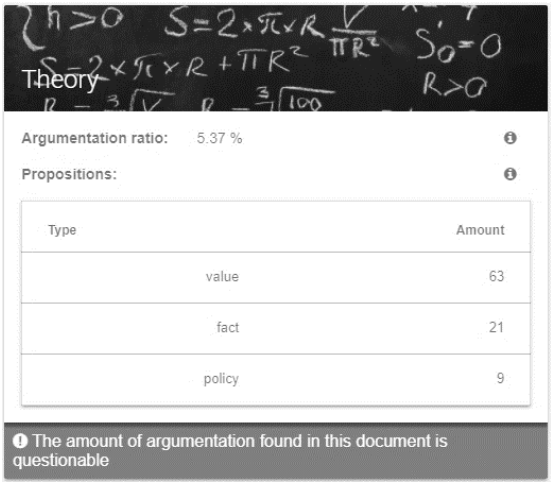

FIGURE 5 SCREENSHOT THEORY TRIANGULATOR

Niculae, Park, & Cardie (2017) describe a factor graph model for argumentation mining named Marseille. They state that in over 20% of web documents argumentative relations do not follow a tree structure. This machine learning based algorithm shows promising results in tests on a web comment dataset (CDCP) as well as an essay dataset. (UKP). While the length of whitepapers is more in line with the UKP dataset. The CDCP dataset allows arguments to contain links all through the document.

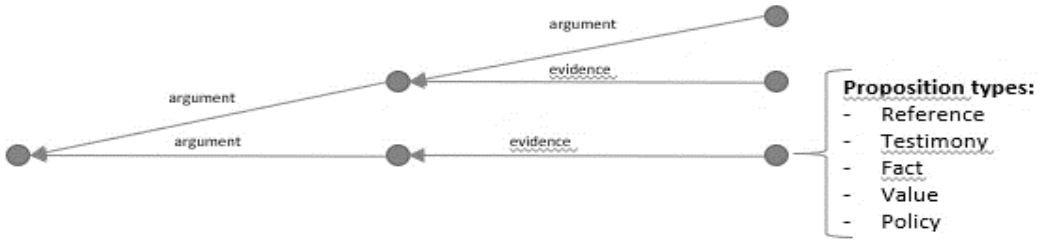

FIGURE 6 MARSEILLE ARGUMENTATION TOPOLOGY BASED ON NICULAE, PARK, & CARDIE (2017)

The algorithm returns a graph instead of a tree with detected statements along with linked arguments the links between arguments can be of the type argument or evidence while the arguments can be classified as facts, references, testimonies, value's and references. This allow us to detect arguments brought up within the document as well as an indication of the completeness of their reasoning. A lack of links indicates a lack of reasoning. Which is valuable information to show to the reader.

5.4 Investigator triangulation

In order to detect the author of a document first of all the metadata of the document is examined if no author could be found we analyse the entities extracted by the information extraction step. We take into account that whitepapers are not only published by individual authors but also by organisations. Therefore, we look at individuals as well as organisations which are widely present in the document. As we cannot determine the author for certain using this method the user is provided with the ability to check and change the detected author

In order to make the reader aware of the background of the author and uncover possible biases the user is presented with a

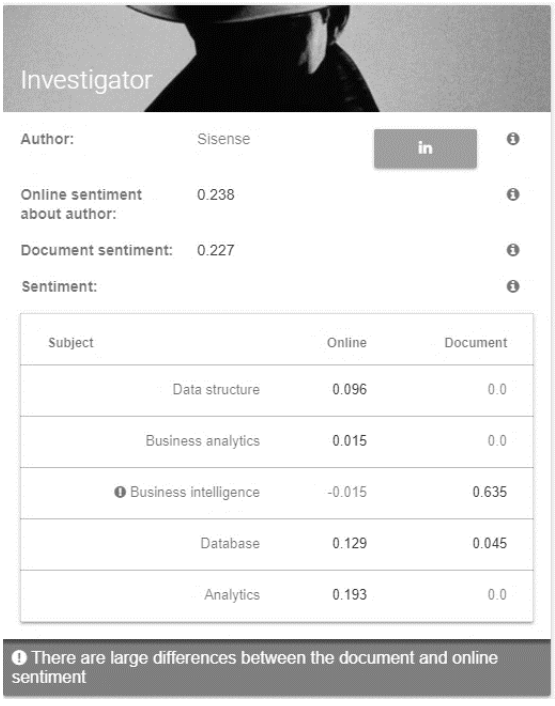

FIGURE 7 SCREENSHOT INVESTIGATOR TRIANGULATOR

LinkedIn page containing information of the user if present. Furthermore, recent news articles from the region of the user concerning the author are presented to create a deeper awareness of the authors background.

A sentiment analysis of the core concepts of the document is used in combination with the sentiment of these concepts on the internet, using a random selection of tweets containing these concepts from the user's geographical region. The differences in sentiment indicate a bias from the author towards a certain concept.

5.5 Methodology triangulator

In order to determine the credibility of the methodology used in a whitepaper we first try to detect which methods are used based on keywords. A list of keywords is created based on the research of (Campanelli & Parreiras, 2015). The document is queried for these keywords. Using the found keywords we try to categorize the methodology in one of the categories described by Campanelli & Parreiras (2015). This categorization enables the user to determine the methods used to establish the document and whether the quality of the methodology used by the author is sufficient. The lack of methodology is also a strong indicator.

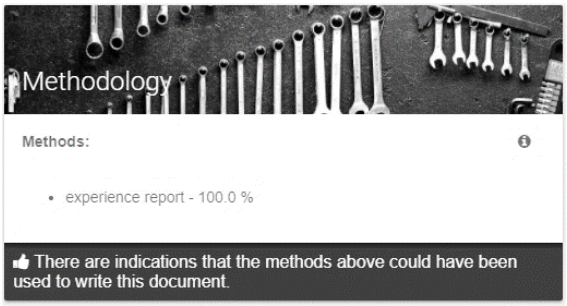

FIGURE 8 SCREENSHOT METHODOLOGY TRIANGULATOR

5.6 Relevance triangulator

To provide the user with information about the relevance of a document this module shows the user the age of the document, concepts discussed in the documents, geographical locations discussed in the document and target audience.

The age of the document can be established using the metadata of the pdf. The information extraction step of the process returns a number of key concepts. These concepts do not contain exact sentences or words contained in the documents but more general subjects. These concepts indicate to the reader whether the document fits within the context of his/her search.

Using the entity extraction search we extract geographical locations contained within the document. Like the concepts these need to be in line with the geographical location of the reader.

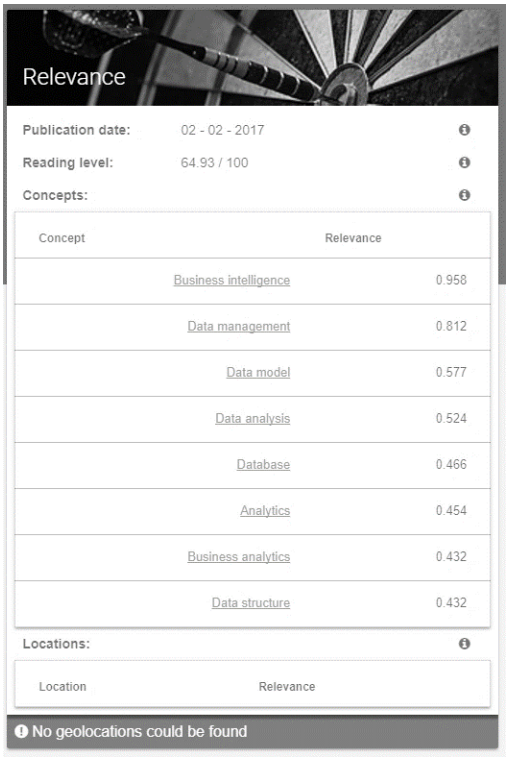

FIGURE 9 SCREENSHOT RELEVANCE TRIANGULATOR

For example: Guideline for it security might differ between countries such as The Netherlands and China, therefore making a case study on this subject in China irrelevant for a Dutch reader.

Finally, we determine the target audience of the writer based on the readability of the document. Dale-Chall's readability score provides a calculation to establish the necessary reading level in order to understand the document. This calculation uses the complexity of individual words within the document.

5.7 Visualizer

As Metzger (2007) sufficient usability is critical to a tool which helps users to determine the credibility of internet documents. Therefore, this design includes a web interface for easy usability. The user is able to upload a document to be analysed. The tool will then provide a report in the form of a webpage. This enables us to show the user graphical interpretations of the analysis which is performed. The user can then use this information to assess the credibility of the document. The webservice to serve this website is build using Flask("Flask," n.d.) a popular Python package to create webservices.

Meta Requirements	Meta Design	Tools used
Data triangulator		
Detect factual statements	Argument extraction	Marseille
Check the correctness of facts	Reference extraction	Regex
Theory triangulator		
Detect ontologies	Concept extraction	IBM Alchemy Language
Detect causal relations	Argument extraction	Marseille
Visualize causal relations	-	-
Detect gaps in causal relations	Argument extraction	Marseille
Investigator triangulator		
Determine author	Metadata extraction	
Determine author background	Web search	Linkedin
Determine author sentiment	Sentiment analysis	RazorText
Compare author sentiment with global sentiment	Sentiment analysis	Twitter
Methodology triangulator		
Determine methods used	Keyword search	
Relevance triangulator		
Determine age of document	Metadata extraction	
Determine context of document	Concept extraction	IBM Alchemy Language
Determine readability of document	Language analysis	Challe-Dalls
Find recent documents about the subject	Web search	

TABLE 10 META REQUIREMENTS AND CORRESPONDING DESIGN CHOICES

6 VALIDATION

In order to verify the design of the whitepaper triangulation tool four case studies were performed to determine the fit of the tool within the PSF selection process. These cases and their findings are discussed below. Next the outcomes of the experiment are discussed.

6.1 Case study

6.1.1 Case I - BI Tool for software supplier

A mid-sized software developer in the Netherlands with an estimated 50 employees found itself looking for a business intelligence (BI) solution to integrate within their own product. This product is used daily by around 150 municipalities and corporate firms. After the strategic decision was made to outsource BI functionality the search for a PSF was started.

First a list of requirements was created based on known bugs, customer requests and innovation wishes. With this list the technical manager started desk research using the internet in order to find possible suppliers. As it turned out the amount of suppliers and information available was too large, demanding too big an investment of time. As a solution a search for consultants with experience in BI tool selection was started. The main selection criteria used were reputation and references. This search yielded three possible consultants, after telephone contact two of the three consultants were eliminated due to strong biases towards one BI tool supplier.

The third consultant advised that the company should still make their own selection but provided aid with comparison research considering the main suppliers of BI solutions. Together with a usability expert and management the technical manager used this research in combination with the list of requirements to create a shortlist of five possible suppliers. Additional information about these five suppliers was found on corporate websites, websites of resellers, whitepapers and business journals. These websites and documents were found using Google. Assessment of the credibility of these documents was mainly done by the technical manager who looked at the credibility of the author, language and references. But found it difficult to assess some documents due to their marketing influences.

Selection of the final supplier was done by the same individuals who created the shortlist. After contact with the suppliers the decision was based on the fit of the requirements, price, reputation and marketing value. As the company wanted to use the partnership with the new supplier as a marketing component. In order to validate the choice for this supplier a proof of concept was created.

While using the proposed whitepaper triangulator the technical manager expressed that the he deemed the indicators provided by the tool relevant. He stated that considering the

provided indicators he would normally not even read the document as these showed that the document contained a strong bias. After reading the whitepaper he found that the author of the document had a strong bias, inline with the finding provided by the investigator triangulator. Furthermore, he noticed that he would not have considered the information provided by the relevance triangulator without the use of the tool while he does acknowledge the importance of for example, publication date.

In addition to the relevance indicators provided by the triangulator the technical manager proposed to add text length as an indicator as he argued that different audiences with different use cases would be looking for documents of varying depth and therefore length. Considering the usability of the tool the technical manager did not recognize the possibility to show tooltips. This lead to difficulties understanding the relevance and context of sentiment scores.

This case shows that while internet information provided the firm with the needed information to perform the supplier selection the amount of available information proofed problematic. In line with the findings of Metzger & Flanagin (2013) the technical manager tasked with assessing the usability and credibility of the found document had difficulties with this process. The use of the developed whitepaper triangulator provided him with indicators which were found helpful during this process.

6.1.2 Case II - Payrolling for mobile app developer

A mobile app developer found itself in need of a new hour registration system for its employees. The first step taken was to use google in order to create an overview of the available solutions and suppliers. No explicit list of requirements was created as the operations manager in lead argued that setting explicit requirements limits the search. His experience had shown him that it is quite helpful if you are open minded towards alternative solutions. He stated that you might otherwise not find solutions to your root problem.

Information about possible suppliers was found on corporate websites, however the operations manager found that these pages tend to be generic and provide less in-depth information about solutions then 5 years ago. Whitepapers were found to provide in depth information. However, the quality of whitepapers was found difficult to assess. The operations manager found that the perceived credibility of whitepapers was mostly based on a gut feeling after reading the documents and was aware that this feeling was sometimes incorrect.

He mentioned a paradox were the vast amount of information available online was difficult to use due the difficulties in assessing this information. Factors which influenced his feeling were: language, author and the amount of argumentation. Case studies or documents describing implementation at a firm within the same context were found most relevant. The firm found that the amount of information available was to large to create a complete overview and took for granted that they possibly missed suppliers due to time constraints.

The operation manager then created a shortlist of suppliers based on price and the number of customers. The number of customers were seen as a first indicator of quality. Other criteria were support, implementation and contract type. The contract type was found important as it influences how quickly the firm would be able to change suppliers if necessary. Finally, employees were involved in the process in order to evaluate the usability and user experience of the proposed solutions. This was found important by the firm as these employees would be the end users of the product.

In contrast to the first case the operation manager did use the tooltips provided by the tool and therefore immediately had a clearer understanding of the provided indicators. He stated that the indicators provided by the tool resembled the gut feeling he mentioned during the interview and would provide a more structured method to evaluate documents. Considering the publication date, he mentioned that this indicator is especially important when selecting IT services due to the quick innovations in this field. The operations manager stated that he found the tool most useful for selecting which documents to read but also expressed a possible use case for authors of whitepapers wanting to evaluate their documents before publication.

The paradox mentioned by the operations manager shows that the problems in assessing online information as found by Metzger & Flanagin (2013) also exist when selecting PSF's. The whitepaper triangulator did provide the operation manager with a structured method to asses the credibility. However, he also indicated that he would use the tool for selection purposes instead of a more critical evaluation of the document.

6.1.3 Case III - Model driven development platform for software supplier

A software developer in The Netherlands started off with the decision to rebuild their 15-year-old software product. In order to do this, they needed a new framework, the strategic decision was made to aim for a model driven development or low code framework.

To select a supplier for this framework the first step was to look at industry journals like the Gardner reports. The credibility of these documents was found questionable as earlier experience had shown that they often lack sources and showed prejudice. Still a number of firms found in these documents was selected and contacted. They were asked who their competitors were in order to get an image of the market and find more possible suppliers.

Next the company went to a demonstration from a software developer who invited multiple low code suppliers who were challenged to develop a simple application. This provided the firm with clear insight in the differences between the suppliers. More information about possible suppliers was found online, testimonials and references from third parties were deemed valuable as well as documents describing implementation of the solution within the same context. Apart from online information the company also called references to hear the experiences off other customers.

The selection was mainly made based on the sustainability of the relation as the only product of the company would depend on the platform and thereby a poor relationship would pose a big risk to the firm. The level of support and a number of proof of concepts were also considered important as did the method of implementation. The selected supplier was directly involved with the implementation process while competitors worked through third party suppliers.

While using the tool, similar to case I the user expressed difficulties understanding the different scores due to not using the tooltips provided by the triangulator. After reading the document and using the triangulator he indicated that the triangulator confirmed his opinion that the document cannot be deemed creditable. This opinion is based on a number of indicators. First, the information provided by the investigator confirmed his initial opinion that the author is biased. Second, he recognized the use of images as marketing and mentions that this indicates a lack of credibility. Finally, he states that he does not find this whitepaper relevant as it uses technical definitions without explaining them. He also mentions that the findings from the methodology triangulator could be helpful as he has a strong preference towards case studies. He thinks that the tool could aid when selecting whitepapers before reading.

6.1.4 Case VI - IT infrastructure

A firm providing administrative software decided to outsource their IT infrastructure in order to gain a better strategic focus and reduce costs. As the firm had limited experience with outsourcing IT services a consultant was hired to aid in the process. This process started with determining the need for outsourcing and requirements for the solution and supplier. The consultant found this the most important step in the process as a clear list of requirements creates a well-defined goal for the supplier.

Next a long list of possible suppliers was created based on information found online. Corporate websites were used but blogs and whitepapers were found to contain more information. The consultant was aware of the possible biases in online information as he stated that every supplier wants to make themselves look as positive as possible, while in practice there will always be negatives. Furthermore, the consultant did not find credibility of these documents important as he found that suppliers would have incentive to keep their promises in order for the relationship to work.

After the creation of the long list a short list was created out of which the top candidate was selected. This was done by application maintainers, system engineers and management based on the requirements, price, mode of implementation and the fit of the company culture of the supplier with that of the firm.

Like case I and case III the consultant did at first not understand the use of the tooltips and therefor the scores provided by the tool. Furthermore, he had difficulties understanding how the findings from the tool related to the triangulated whitepaper. This can be explained by the overwhelmed feeling the user mentioned due to the large amount of information

provided by the triangulator. The consultant mentioned that apart from the indicators currently used by the tool he would propose the addition of a plagiarism check as this would impact the credibility of the author and the document. Finally, he mentioned that he would not use the tool as he deems himself able to critically asses the information and therefore has no use case for a triangulator. This could be due to the fact that he does not find credibility as important as the participants from the other cases.

6.2 Whitepaper triangulation Influence

The mean credibility score of Whitepaper A decreases after triangulation as expected and the mean credibility score of Whitepaper B increases as expected. However, using a paired sample T-test with an α of 0.05 we find no evidence that these changes are caused by the triangulation as the P-value is larger than 0.05. This can be explained by the high standard deviation within the sample groups in combination with the relatively small sample size.

Whitepaper A		
	Reading	Triangulation
Mean	5.8785	5.7385
SD	1.3597	1.4683
N	13	13
INITIAL N	15	15
α	0.05	
T-statistic	0.3510	
P-value	p < 0.001	
Whitepaper B		
	Reading	Triangulation
Mean	5.8325	6.0675
SD	2.205	2.1774
N	12	12
INITIAL N	16	16
α	0.05	
T-statistic	1.3180	
P-value	p < 0.001	

TABLE 11 RESULTS TRIANGULATION INFLUENCE

Using an independent sample T-test with an α of 0.05 we see no statistical evidence that reading the whitepaper before triangulation influences the credibility after triangulation as the P-value is larger than 0.05.

-

Whitepaper A		
Whitepaper A	Only Triangulation	Reading + Triangulation
Mean	4.6000	5.6008
SD	1.9826	2.6792
N	13	13
α	0.05	
T-statistic	1.0826	
P-value	$p < 0.001$	
Whitepaper B		
	Only Triangulation	Reading + Triangulation
Mean	5.7385	6.6546
SD	1.4683	0,9777
N	13	13
α	0.05	
T-statistic	1.8726	
P-value	$p < 0.001$	

TABLE 12 RESULTS ORDER INFLUENCE

7 CONCLUSIONS AND FUTURE RESEARCH

Outsourcing IT services could provide companies better strategic focus and reduced costs. However selection of a professional service firm is a complex decision process in which multiple dimensions need to be evaluated and integrated (Monczka et al., 2016). Furthermore as IT services are considered credence goods an information asymmetry exists due to their technical complexity and specialised knowledge (Howden & Pressey, 2008). Therefore, it is important that companies are in possession of high quality information when making this decision.

According to (Monczka et al., 2016) PSF selection is a structured selection process consisting of seven steps. However, this structured approach was only used in case IV. This can be explained by the influence of the consultant hired to conduct the selection process. In contrast to the other cases this consultant had extended experience in PSF selection processes due to the nature of his professional activities. While the employees in charge of the selection process in the other three cases have previous experience with PSF selection their main responsibilities within their respective firms are different. This lack of experience leads to less structured selection processes in line with a muddling through approach as described by Makkonen et al. (2012).

Although, this muddling through process is less structured we can identify three stages present in all cases: long list creation, shortlist creation and final selection. Between these stages information is gathered in order to make selections. As most firms will not have extensive experience in IT service selection, this muddling through process is more likely to occur. This shows the importance of high quality information during the PSF selection process as this information is needed to make selections between the different stages.

Selection criteria used by firms differ depending on the context of the outsourced IT service as described by Monczka et al. (2016). However, we found that price and a feeling of trustworthiness or reputation were considered in all cases. As Appelman & Sundar (2016) found that credibility is largely build upon trustworthiness the credibility of information could also be used as a selection criteria.

The cases researched in this study show that the primary source of information for firms is the internet. Especially during the longlist and shortlist creation stages firms heavily rely on internet information. Mainly due to the accessibility and availability of this information. However, two firms found that the amount of information online was overwhelming. In case I this even led the firm to try to outsource the selection process itself as they found themselves lacking the skills and resources to efficiently assess all information. This shows that the findings of Metzger & Flanagin (2013), that readers often lack the skills to correctly and efficiently assess online documents, also apply during the PSF selection process.

Documents used during the selection process consist of business journals, corporate websites, comparison sites, blogs and whitepapers. Whitepapers are considered to be especially useful if they describe the implementation and experiences of other firms within the same market. However, the credibility of whitepapers is not guaranteed due to a lack of external creditors. This was confirmed by the case studies as criticism was expressed about the credibility of whitepapers by all participants. Indicating that readers are aware of possible biases within the document. The indicators used by firms to assess the credibility of documents differ. While author and language are used as indicators by most firms there is no clear technique to evaluate documents.

This leads to a paradox, as the internet makes vast amounts of information available to firms the evaluation of these documents has become more difficult, increasing the information asymmetry which applies to credence goods like IT services (Howden & Pressey, 2008). Therefore tooling as proposed by Metzger & Flanagin (2013) is needed to aid in the assessment of online documents and thereby decrease the information assymettry leading to an optimization of the selection process.

Wijnhoven & Brinkhuis (2014) proposed a tool consisting of four triangulators based on the inquiring systems. We build on this idea to design, implement and evaluate a whitepaper triangulator aimed at providing managers with a technique to evaluate the credibility of whitepapers. However in addition to the design of Wijnhoven & Brinkhuis (2014) we introduce a fifth triangulator, the relevance triangulator based on the pragmatic inquiring system. The goal of this relevance triangulator is to determine a measure of fit between the context of the whitepaper and the context of the reader. Thereby indicating the relevance of the whitepaper in the use case of the reader.

While the relevance triangulator was found useful, the specific indicators appear to be context dependent. For example, as IT services are an innovative industry the half-time of knowledge will be short (Arbesman, 2012). Therefore, the publication date is a fitting relevance indicator. While in other industries this might not be the case. Of the numerous relevance factors mentioned by Hjørland (2010) only four: concepts, time, audience and geolocation are currently implemented. Future research should determine when other factors apply to the PSF selection process. In order to further improve the whitepaper triangulator, research into the usability of the tool would be needed. In multiple cases participants did not directly understand the provided indicators or were overwhelmed with the amount of information provided.

We did find that, in the studied cases, the indicators provided by the whitepaper triangulator reflect the criteria used by professionals to determine whitepaper credibility. However, without use of the tool readers are not able to systematically determine and use all indicators. Therefore, they will also not be able to compare the credibility of different documents. The whitepaper triangulator was found useful in three out of four cases. Participants stated that it provided insights into the credibility of the document they did not have after reading and which confirmed their individual assessments. Selection of whitepapers to read based on credibility indicators provided

by the triangulator was mentioned as the most likely use case. This would lead to the use of less biased documents during the selection process thereby decreasing the information asymmetry and enabling firms to make a better judged decision about their professional service supplier. Furthermore, it would aid users in limiting the amount of available information thereby reducing the time needed to perform the selection process. The influence of the tool on the perceived credibility of documents could not be statistically determined, more extensive research would be needed.

A different use case would be the use of the triangulator by the authors of whitepapers in order to evaluate their documents before publication. This would enable writers to detect possible biases in their documents and correct them accordingly. However, the effects of this method would need further research. It is unclear whether this would lead to whitepapers which better reflect reality or whether possible biases would be better disguised, increasing the information asymmetry instead of decreasing it.

8 REFERENCES

Adams, R. J., Smart, P., & Huff, A. S. (2016). Shades of Grey: Guidelines for Working with the Grey Literature in Systematic Reviews for Management and Organizational Studies. *International Journal of Management Reviews*, *0*, 1–23. https://doi.org/10.1111/ijmr.12102

Adomavicius, G., Bockstedt, J. C., Gupta, A., & Kauffman, R. J. (2008). Making Sense of Technology Trends in the Information Technology Landscape. *MIS Quarterly*, *32*(4), 779–809. Retrieved from http://ink.library.smu.edu.sg/sis_research

Allan, B., & Emma, B. (n.d.). *Business Research Methods*.

Appelman, A., & Sundar, S. S. (2016). Measuring message credibility: Construction and validation of an exclusive scale. *Journalism and Mass Communication Quarterly*, *93*(1), 59–79. https://doi.org/10.1177/1077699015606057

Arbesman, S. (2012). Truth decay: The half-life of facts. *New Scientist*. Retrieved from https://www.newscientist.com/article/mg21528831-800-truth-decay-the-half-life-of-facts/

Campanelli, A. S., & Parreiras, F. S. (2015). The Journal of Systems and Software Agile methods tailoring – A systematic literature review. *The Journal of Systems & Software*, *110*, 85–100. https://doi.org/10.1016/j.jss.2015.08.035

Charters, E. (2003). The Use of Think-aloud Methods in Qualitative Research An Introduction to Think-aloud Methods, *12*(2), 68–82.

Churchman, W. (1985). *The Design of Inquiring Systems*. *The Journal of the Operational Research Society* (Vol. 36). https://doi.org/10.1016/0016-3287(72)90061-4

Cleven, A., Gubler, P., & Hüner, K. M. (2009). Design alternatives for the evaluation of design science research artifacts. *Proceedings of the 4th International Conference on Design Science Research in Information Systems and Technology - DESRIST '09*, 1. https://doi.org/10.1145/1555619.1555645

Davide, C., Noordegraaf, J., & Aroyo, L. (2016). Capturing the Ineffable: Collecting, Analysing, and Automating Web Document Quality Assessments. In *EKAW 2016: Knowledge Engineering and Knowledge Management* (Vol. 10024, pp. 83–97). https://doi.org/10.1007/978-3-319-49004-5

De Boer, L., Labro, E., & Morlacchi, P. (2001). A review of methods supporting supplier selection. *European Journal of Purchasing and Supply Management*, *7*(2), 75–89. https://doi.org/10.1016/S0969-7012(00)00028-9

Della, P., Parolo, B., Pan, R. K., Ghosh, R., Huberman, B. A., Kaski, K., & Fortunato, S. (2015). Attention decay in science. *Journal of Informetrics*, *9*, 734–745. https://doi.org/10.1016/j.joi.2015.07.006

Flask. (n.d.).

Franco, L. A., & Meadows, M. (2007). Exploring new directions for research in problem structuring methods: on the role of cognitive style. *The Journal of the Operational Research Society*. Palgrave Macmillan JournalsOperational Research Society. https://doi.org/http://dx.doi.org/10.1057/palgrave.jors.2602346

Gadrey, J., & Gallouj, F. (1998). The Provider-Customer Interface in Business and Professional Services. *Service Industries Journal*, *18*(2), 1–15. Retrieved from https://halshs.archives-ouvertes.fr/halshs-01133184

Girju, R., & Moldovan, D. (2002). Text mining for causal relations. *Proceedings of the FLAIRS Conference*, 360–364. Retrieved from http://www.aaai.org/Papers/FLAIRS/2002/FLAIRS02-071.pdf

Gregor, S. (2006). The nature of theory in Information Systems. *MIS Quarterly: Management Information Systems*, *30*(3), 611–642. https://doi.org/10.2307/25148742

Hallikas, J., Immonen, M., Pynnönen, M., & Mikkonen, K. (2014). Service purchasing and value creation: Towards systemic purchases. *International Journal of Production Economics*, *147*(PART A), 53–61. https://doi.org/10.1016/j.ijpe.2012.10.005

Hevner, A. R. (2007). A Three Cycle View of Design Science Research. *Scandinavian Journal of Information Systems*, *19*(2), 87–92. https://doi.org/http://aisel.aisnet.org/sjis/vol19/iss2/4

Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design Science in Information Systems Research. *MIS Quarterly*, *28*(1), 75–105. https://doi.org/10.2307/25148625

Hjørland, B. (2010). The foundation of the concept of relevance. *Journal of the American Society for Information Science and Technology*, *61*(2), 217–237. https://doi.org/10.1002/asi.21261

Howden, C., & Pressey, A. D. (2008). Customer value creation in professional service relationships: The case of credence goods. *Service Industries Journal*, *28*(6), 789–812. https://doi.org/10.1080/02642060801990361

IBM AlchemyLanguage. (n.d.).

Lacity, M. C., Khan, S. A., & Willcocks, L. P. (2009). A review of the IT outsourcing literature: Insights for practice. *Journal of Strategic Information Systems*, *18*, 130–146. https://doi.org/10.1016/j.jsis.2009.06.002

Lin, X., Spence, P. R., & Lachlan, K. A. (2016). Social media and credibility indicators: The effect of influence cues. *Computers in Human Behavior*, *63*, 264–271. https://doi.org/10.1016/j.chb.2016.05.002

Liou, J., & Chuang, Y.-T. (2010). Developing a hybrid multi-criteria model for selection of outsourcing providers. *Expert Systems with Applications*, *37*, 3755–3767. https://doi.org/doi:10.1016/j.eswa.2009.11.048

Makkonen, H., Olkkonen, R., & Halinen, A. (2012). Organizational buying as muddling through: A practice–theory approach. *Journal of Business Research*, *65*, 773–780. https://doi.org/10.1016/j.jbusres.2010.12.015

Mason, R. O., & Mitroff, I. I. (1973). A Program for Research on Management Information Systems. *Management Science*, *19*(5), 475–487. https://doi.org/10.1287/mnsc.19.5.475

Matsubara, Y., Sakurai, Y., Prakash, B. A., Li, L., & Faloutsos, C. (2012). Rise and fall patterns of information diffusion: model and implications. In *Kdd* (pp. 6–14). Proceedings of the 18th ACM SIGKDD international conference on Knowledge discovery and data mining. https://doi.org/10.1145/2339530.2339537

McCole, P., & Ramsey, E. (2005). A Profile of Adopters and Non-adopters of eCommerce in SME Professional Service Firms. *Australasian Marketing Journal*, *13*(1). https://doi.org/10.1016/S1441-3582(05)70066-5

Medhat, W., Hassan, A., & Korashy, H. (2014). Sentiment analysis algorithms and applications: A survey. *Ain Shams Engineering Journal*, *5*, 1093–1113. https://doi.org/10.1016/j.asej.2014.04.011

Metzger, M. J. (2007). Making Sense of Credibility on the Web: Models for Evaluating Online Information and Recommendations for Future Research. *JOURNAL OF THE AMERICAN SOCIETY FOR INFORMATION SCIENCE AND TECHNOLOGY*, *58*(13), 2078–2091. https://doi.org/10.1002/asi.20672

Metzger, M. J., & Flanagin, A. J. (2013). Credibility and trust of information in online environments: The use of cognitive heuristics. *Journal of Pragmatics*, *59*, 210–220. https://doi.org/10.1016/j.pragma.2013.07.012

Monczka, R. M., Handfield, R. B., Giunipero, L. C., Patterson, J. L., & Waters, D. (2016). *Purchasing & supply chain managment* (4th ed.). CENGAGE.

Niculae, V., Park, J., & Cardie, C. (2017). Argument Mining with Structured SVMs and RNNs. https://doi.org/10.18653/v1/P17-1091

Rieh, S. Y. (2000). *Information quality and cognitive authority in the World Wide Web*. Retrieved from http://hdl.handle.net/10150/106023

Rosenbaum, M. S., Massiah, C., & Jackson Jr, Do. W. (2006). An Investigation of Trust, Satisfaction, and Commitment on Repurchase Intentions in Professional Services. *Services Marketing Quarterly*, *27*(3). https://doi.org/10.1300/J396v27n03_07

TextRazor. (n.d.).

Tiwana, A. (2013). The Peripheral Knowledge Paradox: Interfirm Knowledge Partitioning and Integration in Services Contracting. *Service Science*, *5*(3), 216–237. https://doi.org/10.1287/serv.2013.0044

Toulmin, S. (1958). *The Uses of Argument* (Vol. 70). Cambridge, England: Cambridge University Press. https://doi.org/10.2307/2183556

Von Nordenflycht, A. (2010). What Is a Professional Service Firm? Knowledge-Intensive Firms. *Academy of Management Review*, *35*(1), 155–174. https://doi.org/10.5465/AMR.2010.45577926

Walls, J. G., Widmeyer, G. R., & El Sawy, O. A. (1992). Building an information system design theory for vigilant EIS. *Information Systems Research*, *3*(1), 36–59. https://doi.org/10.1287/isre.3.1.36

Wijnhoven, F. (2011). *Information Services Design: A Design Science Approach for Sustainable Knowledge*. Taylor & Francis group. Retrieved from

http://www.amazon.com/dp/0415899850

Wijnhoven, F., & Brinkhuis, M. (2014). Internet information triangulation: Design theory and prototype evaluation. *Journal of the Association for Information Science and Technology*, *66*(4), 684–701. https://doi.org/10.1002/asi.23203

Yang, D.-H., Kim, S., Nam, C., & Min, J.-W. (2007). Developing a decision model for business process outsourcing. *Computers & Operations Research*, *34*(12), 3769–3778. https://doi.org/10.1016/j.cor.2006.01.012

APENDIX A - INTERVIEW GUIDE

The goal of the interviews is to determine how firms use internet information, and especially whitepapers, when selecting PSF's. Furthermore, we want to determine if the developed triangulation tool can aid firms when selecting PSF's using internet information. To answer these questions the interviews will consist of three parts:

1. A semi structured interview concerning the use of internet information in the existing PSF selection process.
2. A think aloud experiment to determine the usability of the developed tool.
3. A reflective interview to retrieve feedback about the developed tool.

This Interview guide describes the guidelines to be used during the interviews. Interviews will be conducted in Dutch or English depending on the preference of the respondent.

Introduction	
Intro	Introduce the interviewer, ask the respondent if he has any questions about the letter he received.
Research Goal	Introduce the research goal
Topics	The interview consists of three parts: 1. A semi structured interview concerning the use of internet information in the existing PSF selection process. 2. A think aloud experiment to determine the usability of the developed tool. 3. A reflective interview to retrieve feedback about the developed tool.
Anonymity	The results of this interview will be transcribed so they can be used in the research they can be anonymised if this is needed. Discuss the possibilities.
Recording	In order to process the results of this interview we use recording devices. Ask if the respondent agrees with this and tell him/her that recording will be deleted after use.

Semi structured interview questions	
General	- Can you describe the activities of your firm? - Can you describe your function within the firm? - Can you describe your experience in selecting PSF's?
Use of PSF's	- Does your firm use PSF's? o Can you give an example? - For which processes does your firm use PSF's?
Selection of PSF's	- Could you describe the process of selecting a PSF? - Who is involved in this process?

	- What are the criteria used to select a PSF and which are most important?
Use of Internet Information	- Do you use online information when selecting PSF's - In which stage of the selection process do you use this information? (e.g. Search or selection?) - Which kind of online information do you use (e.g. blogs, whitepapers, testimonials, reviews, advertisements)? - Do you use whitepapers when selecting PSF's? - Why do you or do you not use whitepapers?
Assessment of Internet Information	- What do you think of the overall quality of internet information? - What do you think of the overall quality of whitepapers? - How do you assess if the information is credible? o Which indicators do you use? o Do you look at sources? o Do you look at the author? o Do you look at the reasoning used in the Whitepaper? o Do you look whether the conclusions are based on research and how this research is conducted? o Do you look at whether the Whitepaper is relevant? (explain definition of relevant)
Use of tools	- Which tools do you use to find internet information (e.g. Search engines)? - Which tools do you use to determine the credibility of Whitepapers?

Think aloud experiment	
Intro	We have developed a tool which should be able to help you when assessing Whitepapers. This tool analyses the Whitepapers and indicates possible problems. Related to for example Author biases, use of adequate sources, reasoning or relevance to your use case. We want to ask you to use this tool and speak your thoughts aloud. Continuously speaking your thoughts aloud might feel a bit uncommon and unnecessary but it enables us get an insight in your thoughts about the tool which is really useful.
Experiment	- Do not interrupt the respondent while he/she is using the tool - Only encourage the respondent to keep speaking his/her thoughts aloud

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Reflective interview questions	
Intro	The goal of this interview is to answer any questions raised by the think aloud experiment as well as some general questions about the tool.
Think aloud	These questions depend on remarkable thought during the interview noticed by the interviewer.
General	- What do you think about the indicators the tool provided? - Would you have noticed these indicators if you did not use the tool? - Do you think these indicators are useful?

Closing	
Intro	Thank the respondent for his/her participation and explain how the results will be processed, repeat the agreements made during concerning anonymity.
Follow up	Ask the respondent of he/she would be available for follow up questions if needed.
Result	Ask the respondent if he/she would be interested in the outcomes of the research and whether he/she would like to receive a summary of the outcomes

APENDIX B – INTERVIEW TRANSCRIPTIONS

8.1 Participants

Function	Company type	Background	Years of experience
Development manager	Software developer	IT	20
Operations manager	Mobile developer	IT/R&D	25
Director	Software developer	Management	20
IT consultant	Private consultant	IT/Management	30

8.2 Interview I

For which processes does your firm use PSF's?

For services as well as human resources. For example, a business intelligence solution and partnering with other parties which could promote our software inside market segments. We also work together with a company which provides development capacity abroad for us.

Could you describe the process of selecting a PSF?

For example, for a BI solution the most recent one, we started with describing specifications based on bugs, customer requests and our own innovation wishes.
We started with a desk research, in that process we concluded that selection was a lot of work, due to the large amount of solutions. So, we searched for consultants who advice on BI tool selection. Selection of this consultant was mainly done based on references and reputation. This provided us with 3 consultants who we contacted by phone of which two were eliminated due to strong preferences towards one of the possible suppliers.

The last consultant advised us to make the selection on our own with aid of a research they sold us which compared a large number of different BI solutions. This provided us with a top 5 of BI tools, however with this process we heavily relied on this single research. For example, it turned out that two of the 5 suppliers were never contacted by the consultant to answer questions as input for the research.

In the end the selection between these 5 suppliers was made based on price, marketing value and specifications.

Who is involved in this process?

The product owner from a technical perspective, a usability expert to look at usability, and management. In the and management always make the selection.

What are the criteria used to select a PSF and which are most important?

Specifications, marketing value, price and reputation. Reputation mainly because of marketing value and a lower risk. When looking at the selection of our partner which

supplies development personnel abroad we mainly selected using internet information, which country the firm was located as we had previous experience with some countries and time difference.

Do you use online information when selecting PSF's?
Yes, but mostly to search for possible suppliers. I am not sure based on which indicators I select websites. Mostly based on feeling, I did look at references mentioned on these pages. For the BI selection we found so many sources that we outsourced the first selection as I just described.

Which kind of online information do you use (e.g. blogs, whitepapers, testimonials, reviews, advertisements)?
Corporate websites of suppliers and websites of companies who sell the solutions of these suppliers.

Do you use whitepapers when selecting PSF's?
No not much, I actually never explicitly searched for them or ran into them, we did use a Gartner report when selecting a BI tool. We did however not make the selection based on this document as we heard that you are able to pay to be included in these reports. At this moment I am looking into GDPR tools and therefore I read some whitepapers. But most times I do not really find them usable due to marketing influences

So, in the case of the Gartner report you looked at the credibility of the author?
Yes indeed. We also did use the comparison research for the selection of a BI tool. But in that case, we should probably have looked better at the credibility of the author as the research turned out not to be that great.

What do you think of the overall quality of internet information?
I think I am critical enough, I don't claim to know exactly which sources to use but I am aware of the dangers.

Is there a difference between how you use Internet information personally and professionally?
Yes, for personal use I take quality less into account as the stakes are lower.

How do you assess if the information is credible?
It is hard to describe which indicators I use. For example, when selecting a software library, I look at how many people use it and how large the community behind it is. When looking at for example a BI Tool I prefer to get information from a third party and not the supplier directly. The source should be independent.

When the source is indecent does the identity of the source matter?
Yes, the reputation matters as well as the size, I deem larger corporations more important.

And when looking at the contents of a document, do you use indicators to assess this?
The language usage matters. When I can clearly see a marketing influence I take this into account. As well as for example spelling errors and text quality.

Do you look at the amount of argumentation?
I think I do but not consciously, for example you often see that in argumentation a summary is used. But that the same argument is used multiple times within this summary. That's the marketing influence I mentioned. You get the feeling that arguments are added just to increase text length.

Do you look at sources which are mentioned in a document?
They are not often used, but if for example research is used I would look into this. Especially when considering the Gardner reports. So, I would like to see the research.

Which tools do u use when searching for internet information?
Only google, although I do filter out the advertorials I am aware that I depend on the sorting mechanisms of Google.

How much time does the selection process cost?
A lot of time. Reading all the information you find is quite time expensive.

8.3 Interview II

Could you provide some examples about previous IT outsourcing processes?
Yes that is quite broad it entails us as a firm outsourcing certain processes and customers using us as outsourcing suppliers. Quite recently I invested in a new hour registration system for the firm and a new CRM solution.

Can you describe the selection process?
These you start with consulting Google. Off course implicit or explicit you have a set of requirements. The basic requirements a solution has to achieve and off course some budget.

Could you elaborate a bit about implicit or explicit requirements?
Well even if you do not have explicit requirements you always have some expectations a solution should be able to cover. Over the years I have learned that it quite helpful when you are open to alternative solutions. For example, some solutions might fix your root

problem instead of the problem you are trying to fix. Predefined requirements limit your search so I try to be as open minded as possible in this phase.

When do you stop searching?
You are not able to find every solution. One of the aspects I look at is how much a solution is used. As it indicates some kind of quality. The I start comparing by searching for comparison reports and user experience in order to find the best solution. When we are left with a lower number of possible solutions I like to try them to see which solution is best.

Who are involved in these processes?
For example when looking at the hour registration solution I did the first search and selection by myself. But then it becomes very important that the end users provide their opinion. They can evaluate the user experience. So, we ask them to provide input this creates the side effect that implementation will become easier.

Which criteria do you use during the selection?
As I mentioned price and the number of customers. But also, user experience. Quality is off course difficult, the number of users is not always a valid indicator so in the end I would always want to use it myself. Other criteria are the level of support, implementation and contract type. As the contract type influences how quickly, you could change to a different solution when necessary. In the end there is also a factor which is difficult to define, whether the personal contact with the supplier is pleasant some kind of trust factor.

Do these selections cost a lot of time?
It has become easier then 10-15 years ago as a lot of tools are online these days so implementation has become easier. Off course when outsourcing critical business processes, you need to take a lot of time to validate whether a solution is the best solution for the firm as it affects firm performance.

Does the growth in the amount of solutions available during the last 10-15 years make selection more complex?
No, 10-15 years ago you had to call a supplier who would come by and tell you a nice story. These days you have the ability do your own research which is better. On the other hand, you first find a lot of solutions while filtering you always have the risk to eliminate solutions which might actually be superior due to for example low seo rankings.

You already described that the internet is your main source of information while selecting IT outsourcing suppliers, are there also other sources of information you use?

Yes while looking for generic solutions such as CRM suites I also contact relations with the question which solution they use. This is especially useful as a second opinion.

When using internet information which type of sources do you typically use?
Well first of all off course corporate websites, the difficulty with these is that I have the feeling that these tend to contain less information about the actual products and services then a few years ago. What I tend to use is a query like product one vs product 2. This often leads to blogs or for a where people describe their experiences. I do not trust comparison websites and sources like Gardner reports as I know that these work using a buy in principle.

Do you use whitepapers and case studies?
Yes, it is difficult to create an opinion about the credibility of those documents but they tend to provide more in-depth information then corporate websites.

When you try to determine the credibility of whitepapers at which indicators do you look?
That is mainly a gut feeling. So, I am definitely aware of the fact that I might sometimes be wrong.

Are there factors on which that feeling is based?
Well when a document is written from a marketing perspective you will normally be able to determine that quite quickly. That is mainly due to the use of language.

Does layout influence this?
Yes, the more boring a whitepaper looks the more trustworthy it becomes.

Do you look at references and sources in whitepapers?
Not really, I probably scan through them but it doesn't really affect my opinion

Does the author of the document matter?
Yes also because it is quite easy to determine the background of an author by looking at for example LinkedIn. If the author is a marketeer he is less credible then a product expert for example.

Does the amount of argumentation influence your opinion?
Yes off course if a whitepaper only provides an overview it is not of added value compared to a corporate website. If it is more in depth it provides new insights.

How do you determine whether a document is relevant?
For example if it is a case study which describes implementation at another firm it sounds quite relevant.

Does it matter in that case whether the implementing firm is in the same market as yours?
Yes that definitely influences relevance. If the firm is in the same segment it tells you how well the solution would fit with your firm.

8.4 Interview III

For which processes does your firm use PSF's?
Yes, for example: Bi toolkits and external testing of our software. That last one was a company which wrote our test scripts and performed quality testing.

Could you describe the process of selecting a PSF?
Recently we selected a BI tool and a low code framework and for both the process was more or less the same. We look at for example a Gardner report, then we picked a number of firms with which we started a conversation. One of the questions we always ask is who are your competitors? To get a clear view how competitors differ. It is always a good idea to speak with some people within the market to get a view of the market.
For the BI tool we used a list of features with which we compared our requirements to create a shortlist. These features are quite technical. As a firm we also look at the firm who is selling a solution, for example we look at the size to assess whether or not a relationship is sustainable, how much attention the product has within the firm and the marketing opportunities the seller provides for our own product.
When looking at low code, we spoke with two parties and found out there was a demo day from a software supplier. This supplier invited for low code suppliers and challenged them to develop the code for a simple business case in a few hours. This gave us the opportunity to see a clear difference between the different sellers. Especially in the choice for a low code platform we also looked at the sustainability of the relationship, support and a number of proofs of concepts which we did. Also, the implementation method differed between the competitors. For us it was very important the supplier was directly involved

Who is involved in this process?
From IT we involved the manager IT/Product owner, a usability expert in the case of the powerBI tool and management. In a later stage we also involved our support department to assess the supportability of the solution.

Do you use online information when selecting PSF's?
Yes, we mainly use information from the internet. But in both cases, we also called references to hear the experience of current customers.

Which kind of online information do you use (e.g. blogs, whitepapers, testimonials, reviews, advertisements)?
Comparison websites with for example Gardner reports, for a and corporate websites.

Do you use whitepapers when selecting PSF's?
Yes, for BI tooling. In the case of low code platforms, we didn't find them.

And what is your overall view of those documents?
The first thing I always look at is the source, I think 70% of the whitepapers lack sources. If the sources are missing I mostly do not pay a lot of attention to them. A good whitepaper influences me a lot. The same is true for testimonials. A good whitepaper always has some critical notes.

Which indicators do you look at when assessing internet information?
I find references from other customers very important, not only developers but also their users. A good customer references also indicates that the customer is happy enough to help. Apart from that also the indication whether the goal or business case is used. That information is usually missing.

Do you look at the amount of argumentation?
Yes, I do look at argumentation, if it is too much of an overview that is not positive.

Does the methodology used influence you, whether it is based on an experiment or case study?
Not really, however I do find case studies to be more useful but that's about the references used in case studies.

How do you determine whether a whitepaper is relevant for you?
We look for example whether a specific tool has already been implemented in software which is similar to ours. The context has to be the same.

Does layout and language style influence your opinion of a document?
Yes, I think it does, I find it pleasant when images or screenshots are present in the text. Documents written by marketeers are often more an overview, while researchers write about complex models. Actual users provide the most useful insights as they write about implementation challenges.

Which tools do u use when searching for solutions?
Mainly google, now and then Gardner reports or Harvard business reviews. Sometimes I look at what universities write about a subject but it is often difficult to find information about practical problems on those websites.

8.5 Interview IV

What is your current function?
I have worked for almost 30 years in It starting at supporting functions and working up to management. The last years I started as a consultant in business and it. That were I provide organisational advice and development.

Do you have experience with outsourcing IT Services?
A lot of companies still manage a lot of it services on their own, and part of my advice is often to outsource these services. I help those companies with selection of partners. As it could make a firm more efficient. As an external consultant it is easier to keep an overview of the whole process.

When looking at such a selection process who are involved?
Well you start off with determining the reason to outsource, which problem to solve. What are the requirements. Involved with that process are normally application maintainers, system engineers and stakeholders depending on the service which is outsourced. For example, a financial director when financial software is outsourced.

What are the criteria on which a selection is made?
That depends on the organisation and project. You start off with the list of requirements. But it is also important that the company culture of the supplier fits with our own. Price is off course important just like the method of implementation.

When you decided on the goal and start searching for possible suppliers, where do you look for information?
You first create a longlist, a bit of desk research to determine which suppliers are active in the market. Then you contact those suppliers to send you information. As you can ask the questions you will be able to compare answers from different suppliers more easily. This enables you to compare suppliers based on your requirement list. Also, positive experiences by other firms in the same market do matter.

Is internet information used in this process.
Yes off course it starts when creating a long list. Then you start searching which suppliers are available by looking at their websites. If blogs, whitepapers etc. are available you should definitely use them. Comparison websites or websites from market organisations are also often used.

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What do you think of the credibility of online information?
It is off course biased, every supplier wants to make themselves look as positive as possible. In practice there will always also be negatives.

What are indicators you use while reading online information to determine these biases?
I do not think credibility is wat really matters at this stage, it is more about whether they are able to deliver what they promise and whether it looks good and relevant. When you see a website, which has almost no information that does not make a good impression. I do not think that people really use indicators such as sources and references. I also write blogs myself and nobody ever asks me where I do get my information from. Off course whitepapers and blogs in business are often about methods and personal preferences so there is no such thing as factual correctness.
Case studies for example are also always positive because no firm is going to place a negative experience on their website.

How does layout influence this?
Well if they try to hide facts which aren't true with layout this will come to hound in them in the end. As they will be confronted with promises they cannot deliver. IT outsourcing is normally a long-term commitment so as a supplier you would not want this.

Do you use any tools when looking for online information?
Mainly google but through google you also find other websites for example comparison websites.

APENDIX C – THINK ALOUD FINDINGS

8.6 Participant I

Recognizes tooltip tour
User recognizes tooltip instantly, understands usability and reads information.

Appears lost
User appears overwhelmed by the amount of information

Indicates marketing influence on whitepaper
User indicates that he clearly sees the influence of marketing in the document based on line spacing, font and colour usage.

Score indicators are unclear
User does not recognize tooltips and thereby lacks the context of relevance and sentiment scores.

Recognizes author bias
User recognizes that the author is over positive about the subject, in line with the investigator triangulation.

Understand theory triangulator
User recognizes that a low number of propositions is backed by arguments

Expresses usefulness of tool
User expresses that the tool shows useful information and that in this case he would probably not even read the document anymore based on the indicators. He thinks his own judgement would be in line with the tool. But does indicate that he would then blindly trust the tool.

Indicates that he would not have used indicators without tool
States he would have not looked at the publishing date while he does understand the importance of this indicator. Proposes text length as relevance indicator.

8.7 Participant II

User reads tooltips
User reads and uses the information provided by the tooltips

User indicates connection between feeling and indicators
User explains that the indicators represents the feeling he gets with the document.

User would use to tool to select documents
User indicates that he would use the tool to select which papers to read. He would use it to determine which documents are not worth reading.

User mentions usefulness for whitepaper authors
User states that the prototype could improve whitepaper quality when being used by whitepaper authors.

User mentions importance of publishing date.
User mentions that publication date was is especially important when looking at IT products.

User mentions information availability paradox
User tells that there is a paradox while immense amounts of information are available on the internet the usability of this information is difficult to assess due to credibility.

8.8 Participant III

User starts with reading the document.
When presented with the tool the user starts with reading the document.

Directly questions who the author is.
First question of the user when reading the whitepaper is who the author is.

Misses a table of contents
The user indicates that he normally always looks at the table of contents and that in this case this table is missing.

Recognizes images as marketing
User states that images are clearly marketing and indicates that this is not what he is looking for in a whitepaper.

Misses the explanation of technical definitions and the influence on decisions.
User states that he would expect an explanation of technical definitions in the document and questions whether he is the correct audience. He also states that he is normally searching for the impact a certain choice has on his company and misses this information in the document.

States that this is not a useful whitepaper.
User asses this whitepaper as not useful as the information within it is not relevant for him and he questions credibility.

Does not understand the link between the information and the document
User did at first not understand that the triangulated information relates to the document.

Finds the publication date relevant.
User indicates that he thinks the publication date is relevant.

Finds methodology relevant for the credibility.
User indicates that he thinks that knowing that no methodology could be found is interesting.

Finds information about the author.
User sees the information from the investigator triangulator and mentions that this answers his question about the author.

Does not understand sentiment.
While the information behind the tooltip makes it clearer, the user did at first not understand the definition and scales of sentiment.

Triangulation confirms opinion of the user.
User indicates that after reading he did not find the document credible/usable and that after the use of the tool this view has been confirmed.

Indicates that he would use tool to select whitepapers before reading.
User indicates he would read whitepapers different when using this tool, he would use it to select which whitepapers to read.

8.9 Participant IV

User is confused about the document and the results of the triangulation.
The user does not understand whether he is reading the document or triangulating the tool.

User is overwhelmed by the amount of information.
The user indicates that he is overwhelmed by the amount of information and does not find the interface intuitive.

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User misses a logical link between the document and the outcomes of the triangulator.
The user mentions that he misses the link between the document and the outcomes of the triangulator.

User asks whether the internet is searched for documents which use the current document as a source.
The user indicates that he has experience with plagiarism in whitepapers and that this influence credibility for him.

User does not use the tooltips.
The user does not understand a number of indicators, he misses the information which is available in the tooltips.

User indicates that he would not need such a tool.
The user mentions that he does think he is able to critically asses information himself and sees a triangulator as a step to far. He does think it might be helpful for writers of whitepapers.